

## DEVICE AND METHOD FOR WRAPPING BODIES, ESPECIALLY BALES OF HARVESTED AGRICULTURAL PRODUCE

The invention relates to a device for wrapping bodies, especially bales of harvested agricultural produce from hay, straw or wilting green crop with a film.

The invention furthermore relates to a method for wrapping bodies, especially bales of harvested agricultural produce from hay, straw or wilting green crop with a film in the abovementioned device.

Wrapping bales of fresh or wilting grass with a ductile and adhesive film is currently growing more and more popular because the tightly wrapped bales – apart from other advantages – mature into silage within the film wrap in a relatively short period of time without releasing silage fluid that damages the environment, as is the case with clamp silos or silage towers.

Both round and rectangular bales can be wrapped. Currently basically two bale wrapping systems have been introduced into practice. In the case of the so-called wrapping table system, subsequent covering layers of film are placed two to three times around the entire outer bale circumference during the rotation of the bale around a horizontal axis and simultaneous rotation around a vertical axis. In the case of the so-called rotary arm system, the bale is also placed on a type of wrapping table that rotates the bale around its horizontal longitudinal axis, however the wrapping table does not simultaneously rotate around its vertical axis but instead the relative rotation between the bale and the dispensing reel is generated by a rotary arm that circles the bale and holds the film reel at its outermost end.

The silage quality depends on the bale quality on the one hand and the quality of the film wrap on the other hand.

Type, age and wilting degree of the harvested agricultural produce as well as swath preparation and pre-treatment of the harvested agricultural produce (cut or uncut) plus particularly the bale pressing density and shape largely determine the bale quality. Bales with higher pressing density contain a lower portion of air so that within the wrapped bale better silage quality can be achieved.

The quality of the film wrap is determined by the quality of the film, i.e. the manufacturing process (drawn or blown), film thickness, film coloration (white, black, green), tear strength, adhesive force as well as gas permeability and especially also by the carefulness of the operator, i.e. exact adjustment of the pre-stretching process of the film, even film overlapping and correct number of layers as well as careful bale storage.

A high degree of silage quality can only be achieved if all abovementioned conditions are met.

With the combinations of round balers and devices for wrapping the bales that have been introduced recently and are mostly used by wage earners it is therefore up to the carefulness of a single person whether a high-quality silage is obtained or not.

The invention is based on the task of ensuring that the quality of the produced bale silage is revealed for further processing, particularly in the case of feed for high-yielding animals, thus allowing it to be traced back.

This task is resolved with regard to the device in that means are provided for attaching an identification such as a label or a print on, at, in or below the film covering the bale.

With regard to the method, the task upon which the invention is based is resolved in that the means for attaching an identification are controlled in dependence on the degree to which the bale is wrapped by the film.

Based on the invented device and/or the invented method, with appropriate identification,

for example, origin, quality, pressing and/or wrapping date as well as, in particular, the worker or farmer who performed the pressing and wrapping processes can be recognized and traced back at any time. When making the attachment of an identification dependent upon the adherence to previously established requirements during the production of the silage, the identification can serve as a certification mark for consistent quality assurance across the entire production process of the bale silage and also, for example, as a basis for invoicing when marketed since the identification offers an outward advertising effect for the equipment and/or companies that were involved in its production.

In a beneficial embodiment, the identification is a self-adhesive label, for example, consisting of a printed film, which is arranged on a label tape.

In another embodiment, the means comprise a labeling dispensing unit and a pressing element. Conventional label dispensing units ensure a simple feeding process of a label in which a label tape is pulled around a pull-off edge, thus detaching the label and attaching it to and pressing it onto the film wrap of the bale with a pressing element.

Detaching the label from the label tape can be done automatically by the rotating bale or also with the help of mechanical, electric, hydraulic and/or pneumatic auxiliary drives or with a drive source on the tractor.

In another embodiment of the invention, means are provided for imprinting the individual labels separately. Consistent parameters, e.g. the pressed product, are pre-printed onto the label, while changing parameters such as the operator information or the wrapping date are printed individually before or while attaching the self-adhesive labels, mechanically or electronically, upon appropriate input from the operator or based on the bale. If necessary,

the operator can confirm his excellent work at the end by including his signature on the label of a bale.

Generally it is feasible to control the means for attaching identifications in dependence on the wrapping degree of the bale with the film. Since the attached self-adhesive label should not be covered by any more film, it is attached just before, during or just after completion of the wrapping process. In the case of white or nearly transparent films a non-adhesive label can be placed beneath one of the last film layers where it will still be visible despite being covered by the film.

Identifications to be used can include, for example, round or rectangular pre-printed or blank self-adhesive labels or also label tapes or self-adhesive, imprinted film tapes, which are perforated at regular intervals or separated into sections with a cutting device. Similarly, the identification can include electronically captured data in order pick the silage bales, for example, up from the ground with an automated handling system, transport them or process them. So-called 'smart labels' are also feasible, which represent very thin electronic transponders, i.e. transmit-receive devices with microchip and antenna, which are applied to the film.

Additional useful embodiments of the invention result from the remaining sub-claims and the subsequent description of several embodiments of the object of the invention based on the drawings.

They show:

Fig. 1 a first device for identifying a bale wrapped in film with a rotary arm wrapping device

in perspective diagrammatic view in a position of the rotary arm after attaching a label on the bale,

Fig. 2 a label dispensing unit from Figure 1 in enlarged view while pressing a label onto the film that surrounds the bale with a pressing roller,

Fig. 3 a second device for identifying a bale wrapped with a film in perspective diagrammatic view,

Fig. 4 and 5, respectively, another device for identifying a bale wrapped with film in a wrapping table device in perspective view, and

Fig. 6 another device for imprinting a bale wrapped in film on a wrapping table device in perspective view.

The device shown in Figure 1 for wrapping a bale 1 of harvested agricultural produce with a ductile and self-adhesive film 2 is an embodiment with a rotary arm 3 and a stationary wrapping table 4 for holding a bale 1 of harvested agricultural produce, as is basically described in EP 0 234 763 A1. On its outer, lower end, the rotary arm 3 carries a film dispensing reel 5, which is guided around a vertical axis 7 around the bale 1 of harvested agricultural produce during the wrapping process in a rotational movement, wherein a strip of film 8 is pulled off the film dispensing reel 5 and wound around the bale 1 of harvested agricultural produce, which is turning around a horizontal rotational axis 9 in the rotational direction 10. As shown in Figure 1, the entire outer bale circumference has been wrapped, for example, twice with overlapping strips of film so that the wrapping process is just before completion, for which a cutting-and-clamping device (not shown) cuts the strip of film 8 in the

free area between the bale 1 and rotary arm 3 and holds it in place with a clamping process for wrapping another bale 1.

As furthermore shown in Figure 1, a film stretching device 11 is arranged in the path of travel of the strip of film 8 between the film dispensing reel 5 and the bale 1 of harvested agricultural produce, wherein this device 11 includes at least two stretch rollers 12 that are arranged vertically. The film stretching device 11 is fastened to the rotary arm 1 with the dispensing reel 5 as one modular unit.

According to the invention, the film stretching device 11 is followed by a device 13 for identifying a film section 14 on the bale 1 of harvested agricultural produce with a label 15 or a print. In a simple design version, this means a label dispensing unit 16 with a pressing roller 17 that can be activated and brought into an operating position from a resting position 18 away from the bale 1, wherein a label 15 is attached to a previously set position on the film surface and pressed on. The bale 1 and/or the film surface form a counter-force in this case when pressing on the label 15. Figure 1 shows the bale 1 of harvested agricultural produce with the attached label 5.

The label dispensing unit 16 and the attaching process to the bale 1 can best be viewed in Figure 2. The label dispensing unit 16 is equipped with a label dispensing reel 20 that can rotate within a housing 19 and consists of a label tape 21 that is wound onto a reel core (not shown). For the purpose of dispensing a label 15 the label tape 21 is pulled around a pull-off edge 22 through a drive device, thus detaching a label 15, feeding it to a pressing element 17, attaching it on the object that is to be identified and pressing it on. The empty tape 23 is wound onto a take-up roller 24. Hand-held labeling devices of this kind are described, for

example, in EP 0 810 155 B1. These devices however are not suited for applying labels automatically in the case of wrapping devices for bales.

As shown in Fig. 1 and Fig. 2, the invented label dispensing unit 16 is seated in an articulating manner in the horizontal plane on a shaft 25, which is also fastened to the modular unit, parallel and at a distance to the stretch rollers 12. The label dispensing unit 16 can also be arranged on the shaft 25 in such a manner so that its height can be adjusted in order to establish the application area of the label 15 on the film surface. The articulating feature is caused by a hydraulic cylinder 26, which is arranged on the modular unit on the one hand and the label dispensing unit 16 on the other hand. Furthermore a chain sprocket 27 is arranged on the shaft 25, which through a chain 28 or belt drive is connected with a chain sprocket 29 that drives the take-up roller 24 for the label tape 21 when swiveling the label dispensing unit 16 in the rotational direction 30 and thus pulls the label tape 21 from the label dispensing reel 20 around the pull-off edge 22 for a certain distance – thus detaching the label 15 from the tape 23, attaching it to the film surface, as shown in the working position 31 of the label dispensing unit 16 in Figure 2, and running the pressing roller 17 over it while rotating the rotary arm 3 in the rotational direction 6 so that it is firmly attached to the film 2.

For the purpose of controlling the label dispensing unit 16 a sensor 32 is provided, which is arranged in a coaxial manner to the axis 7 on a master hole gage 33, which in turn is connected firmly with the stand 34 for the rotary arm seating. The position of the sensor 32 can be varied either by turning the master hole gage 33 or by inserting it into the different hole patterns. Additionally, the sensor 32 serves as cyclometer for the rotary arm 3 and is connected with an electronic control and evaluation unit 35. Through appropriate angular positions, the sensor 32 can on the one hand effect signals for triggering a cutting-and-

clamping device (not shown), but on the other hand particularly the triggering signal for the drive of the label dispensing unit 16 when the rotary arm 3 passes the sensor 32 before the location where the label 15 is to be attached. The control and evaluation unit 35 works together with a control valve 36 of the hydraulic cylinder 26 in order to effect the motion of the label dispensing unit 16 from the resting position 18 in accordance with Fig. 1 into the operating position shown in Figure 2.

Activation of the label dispensing unit 16 is thus pre-set on the control and evaluation unit 35 and/or on the rotary arm sensor 32 in such a way that the label 15 is attached in the desired location, e.g. in the center of the film width and in the horizontal longitudinal median plane of the bale 1, as shown in Figure 1, wherein the cutting-and-clamping process follows immediately thereafter without covering the label 15 with another layer of film. The area in which the label 15 is attached also depends on how the bale 1 will be stored, i.e. on the front or circumference side. Visibility of the label 15 should be ensured. The advantage of the above solution is particularly that no additional drive devices are required because the already existing rotary motion of the rotary arm 3 is utilized to dispense the label 15 and roll the pressing roller 17 over the label 15 and thus press it onto the bale. In this embodiment, for example, a round pre-printed self-adhesive label with the name of the press manufacturer is used. The size can be about 1/10 of the bale diameter. Of course, any other label designs can be utilized. The label can also include a text area for the signature of the machine operator. In the label dispensing unit 16, a printing device can also be arranged for imprinting the label 15 before dispensing it from the unit, e.g. in order to imprint the wrapping date and/or bale weight onto the label 15 through appropriate sensors and signal transmitters. Similarly, electronic signal transmitters and/or receivers like transponders or other data can



also be stored on the label.

The embodiment, in accordance with Figure 3, only shows a bale 37 on two wrapping rollers 38, 39 in its resting position and wrapped overall with the film. A label dispensing unit 40, in accordance with Figure 2, is arranged in an articulating manner roughly in the center of the bale width on a stationary support shaft 41 that is arranged parallel to the wrapping rollers 38, 39. During bale rotation in the direction marked with the arrow 42, the label dispensing unit 40 is pressed around the shaft 41 in the direction 44 against the film surface by extending a hydraulic cylinder 43, which causes the rotating bale 1 to attach a label strip 45 automatically on its own. The pulled label tape 46 issues a signal when the label has been completely pulled off, thus causing the automatic return of the label dispensing unit 40, for example, through the force of a spring element, into the resting position shown in Fig. 3. Alternatively it is also feasible to stop the bale and move the label dispensing unit along the film surface.

In the embodiment in accordance with Figure 4, a wrapping table device 48 is shown for wrapping a bale 49 of harvested agricultural produce, with the device being pulled during the operation of a tractor (not shown) in the driving direction F. It basically consists of a wrapping table 52, which can be driven around a vertical axis 50 in the rotational direction 51, with drivable rollers 53, which are arranged at a distance from each other and simultaneously move the bale 49 of harvested agricultural produce resting on it around a horizontal bale center line 54 in the rotational direction 55, wherein the bale 49 pulls film 57 off a film dispensing reel 56 over a stretching device (not shown) and wraps it around itself. On the wrapping table 52 a cutting-and-clamping device 58 is arranged. With regard to the design and function, we would like to refer to EP 0 367 529 B1. As shown in Figure 4, a label dispensing unit 59 is no longer arranged in the path of travel of the bale 49, but in the area of

the path of travel of the film 57 between the film dispensing reel 56 and the rotating wrapping table 52. The label dispensing unit 59 corresponds to the one from Fig. 2 and is arranged in an articulating manner around a shaft 61 that is fastened to the stand 60. Since the free film area would move when pressing on the label dispensing unit 59, a freely rotating counter-pressure roller 63, which is seated on the stand 60, presses against the film interior exactly opposite the desired area of attachment of the label 62. For placing the label 62 in the desired location on the bale 49 only the distance between the bale center line 54 and the attachment location of the label 62 must be established. After attaching the label 62 on the film 57, the labeled film section is pulled around the bale 49 through further rotation of the bale 49, thus allowing the label 62 to rest in the desired location X on the bale 49. In a preferred version, the distance of the label dispensing unit 59 can be changed in the feeding direction of the film 57 in order to place a label in various locations on the bale 49.

The device for wrapping a bale 64 of harvested agricultural produce shown in Figure 5 corresponds to the device in accordance with Figure 4, however a label dispensing unit 65 has been arranged in such a way that the label 66 is attached directly on the film 67 resting against the bale 64. The label dispensing unit 65 is seated on the stand 71 in an articulating manner around the axes 70 through a parallel guiding element 68 and hydraulic cylinder 69 roughly in the horizontal longitudinal median plane and is equipped instead of a pressing roller with a hydraulically or pneumatically actuated pressing stamp 72 with a vacuum-and-blow head 73, which can be moved in coaxial direction to the rotational axis 74 of the bale 64 for pressing the label 66 against the bale front. Depending on the position of the wrapping table 75, a label 66 can be selectively placed on the bale front, as shown in Fig. 5, or on the bale circumference in the case of a resting bale 64.

In Fig. 5, the bale 64 of harvested agricultural produce is wrapped with film 67 up to the cutting-and-clamping process. The bale center line 75 is aligned coaxially to the direction of movement of the vacuum-and-blow head 73. For the purpose of labeling the bale 64, the label 66 is initially fed to the vacuum-and-blow head 73, subjected to suction and pressed on the film 67 surrounding the bale 64 while the bale 64 is resting. For detaching the label 66 from the vacuum-and-blow head 73, the device is switched to blowing air, and the label dispensing unit 65 is swiveled back into the position shown in Fig. 5, in which the label dispensing unit 65 is outside the path of travel of the wrapping table 75.

It is basically also feasible to arrange an appropriate label dispensing unit with a pivoting vacuum-and-blow head on the wrapping table 75 and to attach a label during the film wrapping process, i.e. while the wrapping table and the bale are turning. With this process it should be noted that attachment of the label occurs on the bale of harvested agricultural produce beneath the film bottom edge of the last layer of film that was pulled off or that the label dispensing unit must be moved out of the path of travel of the film if additional wrapping processes are supposed to take place.

Alternatively a label dispensing unit (not shown) can also be arranged next to a cutting-and-clamping device 76 for the film on the wrapping table 75 in order to attach a label 77 on the circumference side of the bale 64 on a film section that will not be wrapped any more. The advantage here is that the label 77 is automatically pressed on the film surface again by the rollers 78 while the bale continues to rotate in the rotational direction 79.

Figure 6 shows a device for wrapping a bale 80 of harvested agricultural produce in accordance with Figures 4 and 5, however after the cutting-and-clamping process of the film performed by a cutting-and-clamping device 81. For the purpose of identifying the bale 80, in this example the film 82 is directly imprinted with an ink-jet printer 83. The ink-jet printer 83 is

seated in an articulating manner on the stand 85 with a parallel guiding element 84. After the printing process, the ink-jet printer 83 is moved out of the circular path of the wrapping table 86. When the bale is not rotating, the ink-jet printer is activated, for example, by actuating the cutting-and-clamping device 81 or by triggering the tilt function of the wrapping table 86, after the ink-jet printer has been arranged at the correct distance to the bale surface by a hydraulic cylinder. Instead of the ink-jet printer, simple printing stamps or similar printing means can also be utilized.